Claims

1. A device for monitoring micropollutants in an aquatic environment, which device comprises:

(a) a diffusion-limiting membrane capable of being in contact with the aqueous environment when the device is in use and adapted to allow rate-limited diffusion therethrough of the micropollutants; and,

(b) separated from the aqueous environment by the membrane, a receiving phase having a sufficiently high affinity for the micropollutants for receiving and retaining the micropollutants

characterised in that the receiving phase comprises an immobilised solid phase material supported by a solid support.

2. A device according to claim 1, wherein the solid support is in the form of a solid carrier for the solid phase material, which does not contain or retain water within its structure and can not exchange water with its environment, whereby the solid support is not subject to loss of water and hence changes in dimension, due either

to evaporation or osmotic efflux.

3. A device for monitoring non-polar, organic micropollutants in an aquatic environment, which device comprises:

(a) a diffusion-limiting membrane capable of being in contact with the aqueous environment when the device is in use and adapted to allow rate-limited diffusion therethrough of the micropollutants; and,

(b) separated from the aqueous environment by the membrane, a receiving phase having a sufficiently high affinity for the micropollutants for receiving and retaining the micropollutants

characterised in that the receiving phase comprises an immobilised solid phase material and the diffusion-limiting membrane comprises a solid, hydrophobic polymeric material capable of determining rate of diffusion of the micropollutants therethrough.

4. A device according to any preceding claim, wherein the diffusion-limiting membrane comprises a solid, hydrophobic material, which contains less than 1% water

and/or is substantially non-porous, whereby the diffusion pathway comprises the solid polymer itself and not any water contained therein.

5. A device according to any preceding claim, wherein the diffusion-limiting membrane comprises polyethylene.

6. A device for monitoring micropollutants in an aquatic environment, which device comprises:

(a) a diffusion-limiting membrane capable of being in contact with the aqueous environment when the device is in use and adapted to allow rate-limited diffusion therethrough of the micropollutants; and,

(b) separated from the aqueous environment by the membrane, a receiving phase having a sufficiently high affinity for the micropollutants for receiving and retaining the micropollutants

characterised in that the receiving phase comprises an immobilised solid phase material, and the diffusion-limiting membrane comprises pores traversing the membrane in a direction substantially at right angles to the plane of the membrane and having a diameter in the range of

from 0.1 to 10 mm.

7. A device according to any of claims 1, 2 and 6, suitable for monitoring polar, organic micropollutants, wherein the membrane is selected from polysulphone, polycarbonate, cellulose dialysis membrane, PTFE, PVDF and glass fibre.

8. A device according to any of claims 1, 2 and 6, suitable for monitoring inorganic micropollutants,, wherein the membrane is selected from cellulose acetate, glass fibre membranes, nylon membranes and dialysis membranes.

9. A device according to any preceding claim, wherein the diffusion-limiting membrane is or is associated with a molecular charge selective material

10. A device according to claim 9, wherein the molecular charge selective material is selected from poly(4-vinylpyridine), poly(2,6-dimethylphenol) and perfluorinated polymers having pendant sulphonic acid groups.

11. A device according to any preceding claim, wherein the thickness of the membrane, and therefore diffusion

pathway, is in the range of from 0.02 to 0.15 mm.

12. A device according to claim 11, wherein the thickness of the membrane, and therefore diffusion pathway, is less than 0.1mm.

13. A device according to any preceding claim, wherein the thickness of the receiving phase is less than 1mm.

14. A device according to any preceding claim, wherein the solid, receiving phase is in the form of a cartridge or disk.

15. A device according to any preceding claim, wherein the immobilised solid phase material comprises C_8 to C_{18} chain length hydrocarbon groups bonded in a silica-based polymer.

16 A device according to any preceding claim, wherein the solid support comprises a matrix of fibres.

17. A device according to claim 16 wherein the matrix of fibres comprises hydrophobic fibres.

18. A device according to any preceding claim, wherein the face of the membrane remote from the receiving phase is provided with netting or a mesh.

19. A unit for use as a passive sampling device, which unit comprises a device according to any preceding claim and an inert body adapted to allow insertion therein and removal therefrom of the solid receiving phase and adapted to allow access from the aqueous environment of the micropollutants to the membrane.

20. A device or unit according to any preceding claim, provided with removable means for enabling water or conditioning liquid to be maintained in contact with the solid receiving phase between preparation and use of the device.

21. A unit according to claim 19 or claim 20, or a device according to claim 20, wherein the unit and/or removable means comprise(s) PTFE.

22. A method for monitoring micropollutants in a polluted environment, which method comprises:

(a) providing a receiving phase comprising an immobilised solid phase material for the micropollutants,

which material is supported by a solid support;

(b) providing a diffusion-limiting membrane adapted to allow rate-limited diffusion therethrough of the micropollutants and, in use, adapted to separate the receiving phase from the polluted environment;

(c) bringing the membrane into contact with the polluted environment for a sufficient period of time to allow the micropollutants to collect in the immobilised solid phase material;

(d) removing the solid receiving phase from the environment; and

(e) analysing the micropollutants accumulated in the receiving phase.

23. A method according to claim 22 wherein, in step (d), the sold receiving phase is removed from the environment and separated from the device.

24. A method according to claim 22 or claim 23 wherein the step (e) comprises applying extraction solvent to the receiving phase, whereby the analytes are removed from the receiving phase.

25. A method according to claim 24, wherein the extraction solvent is applied to one face of the receiving phase and is collected, containing the micropollutant analyte(s), at the opposite face thereof.

26. A method according to any one of claims 22 to 25, which further comprises pre-treating the receiving phase by coating or impregnating it with the diffusion-limiting membrane; by conditioning it with a conditioner; or by loading it with internal standard; or any combination thereof.

27. A method according to any one of claims 22 to 26 which further comprises pre-treating the receiving phase by treating it with an agent adapted to complex, chelate or otherwise assist the receiving phase to receive and retain the chosen micropollutant.

28. A method according to any of claims 22 to 27, which further comprises pre-treating the receiving phase by coating or impregnating it with a photometric agent selected from bathocuproine, methylthymol blue, xylenol orange, glycine cresol red, binchinonic acid and 1,5-diphenyl carbohydrazide.

29. A method according to any of claims 22 to 28, which further comprises pre-treating the receiving phase by

coating or impregnating it with an internal standard comprising an isotopically-labelled compound, capable of, during deployment of the device, diffusing from the receiving phase through the diffusion-limiting membrane and into the aquatic environment at a known and controlled rate.

30. A device or method substantially as hereinbefore described, with particular reference to the Figures and Examples.

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